20. FLDWAV MODEL INPUT[1]

The FLDWAV model requires an input file created by the user. Documentation of the data input structure for the FLDWAV model is given in this Section 20. The data is free formatted, i.e., numbers are separated by spaces or commas. Unlike the DAMBRK and DWOPER models which have fixed formatted input structures, all parameter values required by FLDWAV must be entered. Parameters that would normally be left blank must be entered as zero values. Decimal points are required only if the value being entered contains a decimal. Although there is no card coding, the user may add comments for each data group prior to entering the data for the group. In lieu of comments, the user may enter a blank line prior to each data group. A blank line or comment line **must** be entered before each data group except data groups 0-1, 0-2, and 89. **Note: Data sets for the Beta version of FLDWAV will not run on this version (November 1998) of FLDWAV without modification because additional parameters have been added.**

20.1 Input Data Structure and Data Variable Definition for FLDWAV Model

Data Group	Variable Name	Contents
0-1*	MSG	Description of the data set. A maximum of 20 lines is allowed, the last line must be EOM. Each line may have a maximum of 72 characters.
0-2*	DESC	Type of output display. For echo print of the input parameters, enter 'NODESC.' For a description of the model parameters, enter 'DESC'.
1*	EPSY	Depth tolerance in Newton-Raphson Iteration scheme (0.001-1.0 ft). A good value is 0.01 ft.
	THETA	Acceleration factor in solving tributary junction problem (0.5-1.0). Varies with each problem. A good first choice is 0.8.
	F1	θ weighting factor (0.5-1.0) in finite difference technique. A good value is 0.6.
	XFACT	Factor to convert units describing the location of the computational points along the routing reach to feet; e.g., if units are in (mi), XFACT = 5280. When using metric units, this factor converts the units to meters: e.g., if units are in (km),

* Input data group required for any simulation.
** Input data group required for any dam break simulation
DG Abbreviation for Data Group

Data Group	Variable Name	Contents
		XFACT=1000.
	DTHYD	Time interval (hr) of all input hydrographs. If time interval is not constant, set DTHYD = 0. If running in NWSRFS (not in stand-alone mode), set DTHYD > 0.
	DTOUT	Time interval (hr) of all output hydrographs. If running in stand-alone mode (not a part of NWSRFS), set DTOUT = 0.
	METRIC	Parameter indicating if input/output is in English (METRIC = 0) or Metric (METRIC = 1) units. All computations within FLDWAV are done in English units; only the input/output may be displayed in metric units. See Table 20.1 for units conversion information.

Table 20.1. English/Metric Equivalents

Property	English Unit	Metric Unit	Conversion Factor (English to Metric)
Time	hr	hr	
Length	ft	m	1/3.281
Length	mile	km	1.6093
Flow	ft^3/sec	m^3/sec	1/35.32
Area	ft^2	m^2	1/10.765
Surface Area	acres	km^2	1/247.1
Volume	acre-ft	$10^6 m^3$	1/810.833
Weir Coef.	$ft^{1/2}$/sec	$m^{1/2}$/sec	1/1.811
Unit Weight	lb/ft^3	N/m^3	157.1
Shear Strength	lb/ft^2	N/m^2	47.88
Viscosity (Dynamic)	lb sec/ft^2	N sec/m^2	47.88
Manning n	English and Metric are same		

Data Group	Variable Name	Contents

Property	English Unit	Metric Unit	Conversion Factor (English to Metric)

Note: Although the documentation refers to English units only, the metric option is fully functional. This table should be used to determine comparable units and to convert the recommended values to metric units.

2*	JN	Total number of rivers in the system being routed simultaneously.
	NU	Number of values associated with observed hydrographs.
	ITMAX	Maximum number of iterations allowed in the Newton-Raphson Iteration scheme for solving the system of nonlinear equations. If ITMAX = 1, the nonlinear formation degenerates into a linear formation and no iterations are required in the Newton-Raphson iteration procedure. A good value is 10.
	KWARM	Number of time steps used for warm-up procedure. If KWARM = 0, no warm-up is done. If KWARM > 0, the model assumes steady-state initial conditions and will solve the routing equations KWARM times without incrementing the time variable. A good value is 2. If running in NWSRFS (not stand-alone mode) or if initial conditions are not steady-state, set KWARM = 0.
	KFLP	Parameter indicating the use of the floodplain (conveyance) option. If KFLP = 0, no floodplain defined (composite channel used); if KFLP = 1, floodplain used with conveyance (K) generated; if KFLP > 2, floodplain used with K values read in and KFLP is the number of points in the conveyance table.
	NET	Parameter indicating the use of the channel network option. If NET = 0, the network option is not used and a dendritic tree-type system is modeled using the relaxation algorithm. If NET=1, the network option is used.
	ICOND	Parameter indicating the type of initial conditions. If initial conditions were not modified and will not be read in, set ICOND= 0. If initial conditions are read-in, set ICOND=1 and initial conditions at interpolated cross sections will be interpolated between the read-in values. If running in stand-alone mode (not a part of NWSRFS), set ICOND=0.

Data Group	Variable Name	Contents
	IFUT(3)	Future parameters; enter three zero values for future enhancements.
3*	NYQD	Number of sets of stage-discharge values in empirical rating curve at downstream boundary.
	KCG	Number of data points in spillway gate control curve of gate opening (GHT) versus time (TGHT) (DG-38,DG-39). If no movable gates in the system, set KCG = 0.
	NCG	Maximum number of movable gates on any single dam in the system (ICG = 2, DG-29). If no movable gates in the system, set NCG to 0.
	KPRES	Parameter indicating method of computing hydraulic radius (R). If KPRES = 0, then R = A/B where A is cross-sectional flow area and B is channel top width; if KPRES = 1, then R = A/P where P is wetted perimeter.
4*	NCS	Number of values in table of top width (BS) versus elevation (HS). This value applies to all cross sections in the river system.
	KPL	Parameter indicating what information will be plotted. If KPL = 0, nothing is plotted; if KPL = 1, water surface elevation (ft-msl) hydrographs are plotted; if KPL = 2, discharge hydrographs are plotted; if KPL = 3, both are plotted. This parameter has nothing to do with the FLDGRF utility. If running in NWSRFS (not in stand-alone mode) and KPL < 0, stages (ft) will be plotted instead of elevations.
	JNK	Parameter indicating if hydraulic information will be printed. If JNK = 0, nothing will be printed; if JNK > 0, hydraulic information will be printed; if JNK < 0, hydraulic information will be printed for specified reaches. See Table 21.1 for description of intermediate analysis output. A good value is JNK = 4 or 5.
	KREVRS	Parameter indicating use of the low flow filter. If KREVRS = 0, the low flow filter is activated preventing the water surface elevations (WSELs) and discharges from going below the initial condition values; if KREVRS = 1, the low flow filter is off and reverse flow is allowed.

Data Group	Variable Name	Contents
	NFGRF	Parameter indicating if data needed for the FLDGRF utility will be generated. If NFGRF = 0, the data will be generated; if NFGRF = 1, the data will not be generated.
5*	IOBS	Parameter indicating if observed data are available at gaging stations. If IOBS = 0, no data available; if IOBS = 1, data is available; if IOBS=2, observed data are available and the forecast stages will be adjusted using Manning n ranges; if IOBS=3, observed data are available and the forecast stages will be adjusted using specified balances; if IOBS = -1, a mathematical function is used to describe the inflow hydrograph. If running in stand-alone mode (not a part of NWSRFS), IOBS must be less than 2.
	KTERM	Parameter indicating if the terms in equation of motion will be printed as special information. If KTERM = 0, they will not be printed; if KTERM = 1, they will be printed. Normally use KTERM = 0.
	NP	Parameter indicating if Automatic Calibration option is used. If NP = 0, calibration is not used; if NP = -1, automatic calibration of the roughness coefficient (n) is done; if NP = -4, automatic calibration of n using average cross sections is done.
	NPST	Parameter indicating the first value in the computed stage hydrograph which will be used in the statistics needed in the automatic calibration option to determine the Manning n. If NPST = 0, the first value of observed stage hydrograph will be used. If NP = 0, set NPST = 0.
	NPEND	Parameter indicating the last value in the computed stage hydrograph which will be used in the statistics needed in the automatic calibration option to determine the Manning n. If NPEND = 0, the last value of observed stage hydrograph will be used. If NP = 0, set NPEND = 0.

Skip DG-6 if JNK is greater than or equal to 0.

Data Group	Variable Name	Contents
6	TDBG1	Time at which additional intermediate analysis information begins.
	TDBG2	Time at which additional intermediate analysis information ends.

Data Group	Variable Name	Contents
	JNKDBG	Intermediate analysis output indicator (JNK, DG-4). See Table 21.1 for available intermediate analysis output types.
	JDBG1	First river at which additional intermediate analysis information will be applied.
	JDBG2	Last river at which additional intermediate analysis information will be applied.
	LDBG1	First reach at which intermediate analysis information will be applied during calibration. If NP = 0 (DG-5), LDBG1 is the first cross section where intermediate analysis will be applied during simulation.
	LDBG2	Last reach at which intermediate analysis information will be applied during calibration. After this reach has been calibrated, the model will stop. If NP = 0 (DG-5), LDBG2 is the last cross section where intermediate analysis will be applied during simulation.
	MCMDBG	First iteration during calibration at which intermediate analysis information will be printed. If NP = 0 (DG-5), set MCMDBG=0.
7*	TEH	Time (hr) at which routing computations will terminate. If running in NWSRFS (not stand-alone mode), set TEH = 0.
	DTHII	Initial computational time step. If DTHII > 0, a constant time step is used; if DTHII = 0, a variable time step is used based on the inflow hydrographs and dam failure times. If DTHII < 0, an array of time steps (NDT values) will be read in where NDT = the absolute value of DTHII.
	DTHPLT	Time step (hr) at which computed/observed hydrograph data are stored for plotting or printing. If DTHPLT = 0, then set DTHPLT = DTHII. If KPL = 0 (DG-4), set DTHPLT = 0.
	FRDFR	Window for critical Froude number in mixed-flow algorithm. Froude numbers in the range of (1+/- FRDFR) will be treated as though the Froude number is equal to 1. The default value is 0.05.
	DTEXP	Computational time step (hr) for explicit routing. If DTEXP >

Data Group	Variable Name	Contents
		0, then a constant time step is used. If DTEXP < 0, then a variable time step is used based on the Courant number (C_n) where C_n = the absolute value of DTEXP. If explicit routing is not used, set DTEXP = 0.
	MDT	Divisor for determining the time step ($\Delta t = t_p/MDT$). A good value is 20 for subcritical flow or 40 for supercritical flow. If a constant time step is read-in (DTHII not equal to 0), set MDT=0.

Skip DG-8 and DG-9 if time step array is not used (DTHII greater than or equal 0).

8	DTHIN(K)	Computational time step to be used until time TDTIN(K). K index goes from 1 to NDT (DG-7).
9	TDTIN(K)	Time at which DTHIN(K) is no longer used. K index goes from 1 to NDT (DG-7).
10*	NLEV	Total number of cross-section reaches in the system that have levees.
	DHLV	The difference between the maximum and minimum crest elevations along the reach (this is sometimes useful to prevent numerical problems with suddenly large outflows when the levee is first overtopped. If NLEV = 0, set DHLV to zero.
	DTHLV	Computational time step to be used during levee overtopping/failure. If NLEV = 0, set DTHLV = 0.

Skip DG-11 if no levees in the system (NLEV = 0).

11	NJFM(K)	Sequence number of river from which levee overtopping/failure flow is passed from reach K.
	NIFM(K)	Sequence number of reach along the river from which levee flow passing into reach NITO(K).
	NJTO(K)	Sequence number of river or pond receiving flow from levee overtopping/failure in reach K.
	NITO(K)	Sequence number of the reach along the river receiving flow from reach NIFM(K). If the receiving channel is a pond (i.e.,

Data Group	Variable Name	Contents
		level pool routing done), set NITO(K) = 0.

Repeat DG-11 for each levee reach (K=1,NLEV).

12*	NBT(J)	Total number of actual cross sections on river J.
	NPT(1,J)	Beginning cross-section number (after interpolation) on river J for which intermediate analysis information will be printed. This parameter is required when JNK is greater than or equal to 9 .
	NPT(2,J)	Final cross-section number (after interpolation) on river J for which intermediate analysis information will be printed. This parameter is required when JNK is greater than or equal to 9.
	MRV(J)	Number of river into which river J flows. Omit this field for main river (J=1). Note that tributary (J-1) is river J.
	NJUN(J)	Sequence number of cross section immediately upstream of tributary (J-1) confluence (this section coincides with the upstream extremity of the small sub-reach which is equivalent in length to the tributary width). Omit this field for main river (J=1).
	MRU(J)	Number of river from which river J flows (feeding river). For dendritic rivers (i.e., upstream end of river is not connected to another river), set MRU(J)=1. Omit this field for the main river (J=1), or if the network option is not used (NET=0, DG-2).
	NJUM(J)	Sequence number of cross section immediately upstream of confluence of the feeding river - MRU(J) (this section coincides with the upstream extremity of the small sub-reach which is equivalent in length to the tributary width). For dendritic rivers (i.e., upstream end of river is not connected to another river), set NJUM(J)=1. Omit this field for the main river (J=1), or if the network option is not used (NET=0, DG-2).
	ATF(J)	Azimuth angle (degrees) that tributary J makes with the main river at the confluence. Omit this field for main river (J = 1).
	EPQJ(J)	Discharge tolerance in Newton-Raphson Iteration scheme in main river (J=1) or in Tributary Iteration Scheme (J > 1).
	COFW(J)	Coefficient of wind stress (1.1E-06 to 3.0E-06) on river J.

Data Group	Variable Name	Contents
	VWIND(J)	Wind velocity (ft/sec) on river J; (+) if directed upstream; (-) if directed downstream.
	WINAGL(J)	Acute angle (degrees) that wind makes with the channel axis of river J.

Repeat DG-12 for each river (J=1,JN).

13*	KU(J)	Parameter indicating the type of upstream boundary condition being specified for the main river and tributaries; if KU(J) = 1, a stage hydrograph is the upstream boundary condition; if KU(J) = 2, a discharge hydrograph is the upstream boundary condition.
	KD(J)	Parameter indicating the type of downstream boundary condition being specified for the main river (KD(1)) and the tributaries (KD(J) where J goes from 2 to JN); if KD(1)=0, an observed tide hydrograph is specified which will be blended with a simulated tide hydrograph; if KD(1) or KD(J) = 1, a stage hydrograph is the downstream boundary condition; if KD(1) = 2, a discharge hydrograph is the downstream boundary condition; if KD(1) = 3, a single-valued rating curve of discharge as a function of stage is the boundary condition; if KD(1) = 4, a looped rating curve is generated based on Manning's equation where the friction slope is computed based on the momentum equation; if KD(1) = 5, normal flow computed from Manning's equation is the downstream boundary condition; if KD(1) = 7, a looped rating curve is generated where the friction slope is computed based on conveyance; if KD(1) = 1 and NYQD > 0, a single-valued rating curve in which Q is a function of the computed water surface minus the read-in value of STN is the boundary condition. If running in stand-alone mode (not a part of NWSRFS), KD(1) must be greater than zero. In the case of tributaries, a stage hydrograph is generated at the downstream boundary and KD(J) is always equal to zero.
	NQL(J)	Total number of lateral flows on river J.
	NGAGE(J)	Total number of observed time series along river J (routing reach) which will be compared with computed time series; also, denotes total number of stations for which computed values will be plotted independently of FLDGRF.
	NRCM1(J)	Total number of Manning n reaches on river J.

Data Group	Variable Name	Contents
	NQCM(J)	Total number of values in the Manning n table. Also, denotes whether Manning n is a function of water surface elevation (NQCM(J) > 0) or discharge (NQCM(J) < 0). If NQCM(J) = 0, Manning n is a function of water surface elevation and the number of table values is equal to NCS.
	NSTR(J)	Total number of computed time series (stage, discharge, or velocity) to be stored on each river. (Number of output time series on each river). If running in stand-alone mode (not a part of NWSRFS), set NSTR(J)=0.
	IFUT(3)	Future parameters; enter three zero values for future enhancements.

Repeat DG-13 for each river (J = 1,JN).

14*	MIXF(J)	Parameter indicating the flow regime in river J. If MIXF(J) = 0, river J has subcritical flow; if MIXF(J) = 1, river J has supercritical flow; if MIXF(J) > 1, there is a mixture of subcritical and supercritical flow throughout river J at varying times; if MIXF(J) = 2, the hydraulic jump can move upstream or downstream; if MIXF(J) = 3, the hydraulic jump moves only if the Froude number exceeds 2; if MIXF(J) = 4, the hydraulic jump is stationary; if MIXF(J) = 5, a modified implicit technique (LPI) is used to solve mixed flows.
	MUD(J)	Parameter indicating the use of the mud/debris flow option on river J. If MUD(J) = 0, dynamic routing of non-mudflow (water) will be done; if MUD(J) = 1, dynamic routing of mudflow using the visco-plastic technique will be done; if MUD(J)=2, dynamic routing of mud/debris flow using the granular sliding technique will be done
	KFTR(J)	Parameter indicating the use of Kalman filter option on river J. If KFTR(J) = 0, Kalman filter option is not used; if KFTR(J) = 1, Kalman filter option will be used. Kalman filter can be turned on to update the forecast if river J has stage observations for more than 2 gaging stations.
	KLOS(J)	Parameter indicating the computation of volume losses in river J. If KLOS(J) = 0, the losses will not be computed; if KLOS(J) = 1, the losses will be computed.

Data Group	Variable Name	Contents
	IFUT(6)	Future parameters; enter six zero values for future enhancements.

Repeat DG-14 for each river (J = 1,JN).

Skip DG-15 if LPI technique is not used in system (all MIXF(J)'s are not equal to 5).

15	KLPI(K)	Power (m) used in the LPI technique. Values range from 1 to 10 where m = 10 approaches the fully dynamic technique and m = 1 approaches the diffusion technique. K index goes from 1 to the number of rivers using the LPI technique. A good value is 5.

Skip DG-16 if MUDFLOW option is not used in system (all MUD(J)'s = 0).

16	UW1(J)	When using the visco-plastic technique (MUD(J)=1), UW1(J) is the unit weight (lb/cu-ft) of mud/debris fluid in river J; when using the granular sliding method, UW1(J) is the friction angle of debris sediment on the channel bed of river J.
	VIS1(J)	Dynamic viscosity (lb-sec/sq-ft) of mud/debris fluid in river J. Omit this field if MUD(J) is not equal to 1.
	SHR1(J)	Initial yield stress of shear strength (lb/sq-ft) of mud/debris fluid on river J. Omit this field if MUD(J) is not equal to 1.
	POWR1(J)	Exponent in power function representing the stress-rate of strain relation of fluid in river J; if Bingham plastic is assumed for fluid, set POWR1(J) = 1.0. Omit this field if MUD(J) is not equal to 1.
	IWF1(J)	Parameter indicating dry bed routing on river J. If IWF1(J) = 0, the base flow at t=0 will be used all along the routing reach; if IWF1(J) > 0, wave front tracking will be used where the wave front velocity (V_w) is a function of the channel velocity (V); if IWF1(J)=1, $V_w = V_{N-4}$; if IWF1(J)=2, $V_w = (K_W)(V_{N-4})$; if IWF1(J) = 3, $V_w = V_{max}$, where V_{max} is the maximum velocity in the channel reach, N is the current location of the wave front and K_W is the kinematic wave factor. Omit this field if MUD(J) is not equal to 1.

Repeat DG-16 for each river with mudflow (MUD(J) > 0, J = 1,JN).

Skip DG-17 if volume flow losses are not computed in system (all KLOS(J)'s = 0).

Data Group	Variable Name	Contents
17	XLOS(1,J)	Beginning location (mi) of the reaches where flow loss will occur on river J.
	XLOS(2,J)	Ending location (mi) of the reaches where flow loss will occur on river J.
	QLOS(J)	Percentage of the loss in terms of total active flow amount; (-) for loss and (+) for gain.
	ALOS(J)	Loss distribution coefficient for river J (0.3-3.0). For a linear loss distribution, set ALOS(J) = 1.

Repeat DG-17 for each river with volume flow losses (KLOS(J) > 0, J = 1,JN).

18*	XT(I,J)	Location of station or cross section where computations are made (units can be anything since XFACT converts these units to ft); I index goes from 1 to NBT(J).
19*	DXM(I,J)	Minimum computational distance step between cross sections. If DXM(I,J) is less than the distance between two adjacent cross sections read in, then intermediate cross sections are created within the program via a linear interpolation procedure. I index goes from 1 to NBT(J)-1.
20*	KRCHT(I,J)	Parameter indicating routing method or internal boundary condition in each reach. See Table 20.2 for a description of each type. I index goes from 1 to (NBT(J)-1).

Repeat DG-18 through DG-20 for each river (J=1,JN).

Skip DG-21 through DG-25 if NLEV = 0.

21	HWLV(L)	Elevation (ft-msl) of top of levee, ridge line, etc. where weir-flow occurs. This elevation is located on the upstream end of the levee reach. If HWLV(L) < 0, discharge flows through a pipe and the absolute value of HWLV(L) is the invert elevation of pipe.

Data Group	Variable Name	Contents

Table 20.2. Routing Methods and Internal Boundaries

KRCHT(I,J)	Definitions
0	Implicit Dynamic Routing
1	Implicit (Diffusion) Routing
4	Level Pool Routing
5	Explicit Dynamic Routing (Upwind)
6	Implicit (Local Partial Inertial) Routing
10	Dam
11	Dam + Q=f(Y)
21	Dam + Y=f(Q)
12	Dam + Q=f(YY)
15	Dam + Average Movable Gates (Corps of Engineers Type)
28	Lock and Dam
35	Bridge

Variable Definitions

Q=flow
Y=pool elevation
YY=tailwater elevation
HG=centerline of gate
C=gate coefficient
FR=Froude number

WCLV(L) Weir-flow discharge coefficient for Δx reach where weir flow (inflow or outflow) may occur. Coefficient ranges from 2.6 to 3.2; if there is a pipe connection(HWLV(L) < 0), the weir coefficient = the absolute value of (8.02 times the discharge loss coefficient times the maximum area of the pipe).

TFLV(L) Time (hr) from start of levee failure (crevasse) until the opening or breach is its maximum size. Set TFLV(L)=0 if the levee does not fail.

BLVMX(L) Final width (ft) of levee crevasse which is assumed to have a rectangular shape (200-5000 ft). Set BLVMX(L) = 0 if the levee does not fail.

HFLV(L) Elevation (ft-msl) of water surface when levee starts to fail. Set HFLV(L) = 0 if the levee does not fail.

HLVMN(L) Final elevation (ft-msl) of bottom of levee crevasse. Set

Data Group	Variable Name	Contents
		HLVMN(L) = 0 if the levee does not fail.
	SLV(L)	Slope of levee L (ft/ft). This parameter is used to interpolate levee reaches. Interpolation is done from the upstream end of the reach.

Skip DG-22 if levee has no drainage pipe (HWLV(L) is greater than or equal to 0).

22	HPLV(L)	Centerline elevation (ft-msl) of flood drainage pipe (with flood gate).
	DPLV(L)	Diameter (ft) of flood drainage pipe.

Repeat DG-21 and DG-22 for each levee reach (L = 1,NLEV).

Skip DG-23 through DG-25 if no ponds exist in the system (NITO(L) > 0, L=1,NLEV).

23	HPOND(L)	Initial water surface elevation (ft-msl) of storage pond L in levee option.
24	SAPOND(K,L)	Surface area (acres) of storage pond L corresponding to elevation HSAP in the area-elevation curve. These values should be entered from the top of the pond (maximum elevation) to the bottom. K index goes from 1 to 8. If less than 8 values are needed to describe the pond, set the remaining values to zero.
25	HSAP(K,L)	Elevation (ft-msl) corresponding to SAPOND in the area elevation curve. These values should be entered from the top of the pond (maximum elevation) to the bottom. K index goes from 1 to 8. If less than 8 values are needed to describe the pond, set the remaining values to zero.

Repeat DG-23 through DG-25 for each pond (L = 1 to number of ponds).

Skip DG-26 through DG-47 if no internal boundaries in the system (all KRCHT < 10).

Skip DG-26 through DG-43 if internal boundary K is not a dam (KRCHT(K,J) < 10 or KRCHT(K,J) > 30).

Skip DG-26 and DG-27 if internal boundary K is not a reservoir (KRCHT(K,J) is not equal to 4 or [KRCHT(1,J) < 10 or KRCHT(1,J) > 30]).

Data Group	Variable Name	Contents
26	SAR(L,K,J)	Surface area (acres) of reservoir behind dam at elevation HSAR(L,K,J). Values should be read in from the top of the reservoir to the bottom of the reservoir. L index goes from 1 to 8; if less than 8 values are needed to describe the reservoir, set the remaining values to zero.
27	HSAR(L,K,J)	Elevation (ft-msl) at which reservoir surface area SAR(L,K,J) is defined. Values should be read in from the top of the reservoir to the bottom of the reservoir. L index goes from 1 to 8; if less than 8 values are needed to describe the reservoir, set the remaining values to zero.
28**	LAD(K,J)	Reach number corresponding to location of dam K.
	HDD(K,J)	Elevation (ft-msl) of top of dam.
	CLL(K,J)	Length (ft) of the dam crest less the length of the uncontrolled spillway and gates. If CLL(K,J) is entered as a negative value, the length of the dam crest is variable with elevation and will be specified later as DG-30 and DG-31.
	CDOD(K,J)	Discharge coefficient for uncontrolled weir flow over the top of the dam (2.6-3.1).
	QTD(K,J)	Discharge (cfs) through turbines. This flow is assumed constant from start of computations until the dam is 1/4 breached; thereafter, QTD(K,J) is assumed to linearly decrease to zero when ½ breached; QTD(K,J) may also be considered leaking or constant spillway flow. If this flow is time-dependent, QTD(K,J) is entered with any negative value and the time series for QTD(K,J) is specified later on DG-32 and DG-33.
	ICHAN(K,J)	Parameter indicating if channel conditions at dam K will switch from manual control (e.g., lock and dam controlled by the lockmaster) to channel control (i.e., unsteady flow conditions). If no manual control, set ICHAN(K,J) = 0; if channel control switch is allowed, set ICHAN(K,J) = 1; if a rating curve is used for the lock and dam, set ICHAN(K,J)=2; if target pool elevation is used exclusively, set ICHAN(K,J)=3.

If dam is represented by a rating curve only, set all values in DG-28 to zero except LAD(K,J).

Data Group	Variable Name	Contents
29**	ICG(K,J)	Parameter indicating type of movable gate structure. If ICG(K,J) = 0, no movable gates exist; if ICG(K,J) = 1, movable gates exist using an average gate opening; if ICG(K,J) = 2, multiple movable gates exist with independent gate openings.
	HSPD(K,J)	Elevation (ft-msl) of uncontrolled spillway crest. If no spillway exists, set HSPD(K,J) = 0.
	SPL(K,J)	Crest length (ft) of uncontrolled spillway. If no spillway exists, let SPL(K,J) = 0.
	CSD(K,J)	Discharge coefficient of uncontrolled spillway (2.6-3.2). If CSD(K,J) < 0, the failure starts in the spillway at its crest and failure is confined to a length of the spillway. If no spillway exists, set CSD(K,J) = 0. If spillway is represented by an empirical rating curve, set CSD(K,J) = 0 and HSPD(K,J) > 0. Note that only one empirical rating is allowed at the dam. If several rating curves exist at the dam, they should be combined and entered as one rating curve.
	HGTD(K,J)	Elevation (ft-msl) of center of gate openings for average moveable gates.
	CGD(K,J)	Discharge coefficient for gate flow (0.60-0.80) times the area of the gates (sq-ft). If no gate exists, set CGD(K,J) = 0. If gates are represented by an empirical rating curve, set CGD(K,J) = 0. Note that only one empirical rating is allowed at the dam. If several rating curves exist at the dam, they should be combined and entered as one rating curve. If the average moveable gate option is used and submergence effects are expected, an empirical rating curve with built-in submergence should be used.

If dam is represented by a rating curve only, set all values in DG-29 to zero except HSPD(K,J).

Skip DG-30 and DG-31 if the dam crest length is constant (CLL(K,J) is greater than or equal to 0, DG-28).

Data Group	Variable Name	Contents
30	HCRESL(L,K,J)	Elevation (ft-msl) associated with variable length of dam crest, CRESL(L,K,J), for dam. Values should be read-in starting at the minimal crest elevation to the maximum elevation. L index goes from 1 to 8; if less than 8 values are needed to describe the

Data Group	Variable Name	Contents
		dam crest, set the remaining values to zero.
31	CRESL(L,K,J)	Variable length (ft) of dam crest for a given elevation, HCRESL(L,K,J). L index goes from 1 to 8; if less than 8 values are needed to describe the dam crest, set the remaining values to zero.

Skip DG-32 through DG-39 if running in NWSRFS (not stand-alone mode).

Skip DG-32 and DG-33 if the turbine flow is constant (QTD(K,J), DG-28, is greater than or equal to 0).

Data Group	Variable Name	Contents
32	QTT(L,K,J)	Variable discharge (cfs) through the turbines; this flow is time dependent. L index goes from 1 to NU (DG-2).
33	TQT(L,K,J)	Time (hr) associated with discharge through turbines, QTT(L,K,J). L index goes from 1 to NU (DG-2).

Skip DG-34 and DG-35 if no rating curve is generated for the spillway or gate structure (KRCHT(K,J), DG-20,) is not equal to 11,21,12).

Data Group	Variable Name	Contents
34	RHI(L,K,J)	Head (ft) above spillway crest or gate center. Head is associated with spillway or gate flow, RQI(L,K,J), in rating curve. L index goes from 1 to 8; if less than 8 values are needed to describe the rating curve, set the remaining values to zero.
35	RQI(L,K,J)	Discharge (cfs) of spillway or gate rating curve corresponding to RHI(L,K,J). L index goes from 1 to 8; if less than 8 values are needed to describe the rating curve, set the remaining values to zero.

Skip DG-36 through DG-39 if no multiple movable gates (KRCHT(K,J) is not equal to 14).

Data Group	Variable Name	Contents
36	NG(K,J)	Number of movable gates in dam K.
37	GSIL(L,K,J)	Elevation (ft-msl) of the bottom of gate L.
	GWID(L,K,J)	Width of gate opening on gate L.

Data Group	Variable Name	Contents
38	TGHT(I,L,K,J)	Time (hr) associated with gate opening GHT(L,K,J). I index goes from 1 to KCG (DG-3).
39	GHT(I,L,K,J)	Distance (ft) from bottom of gate to gate sill, GSIL(I,L,K,J). This distance is time dependent and is associated with the time array TGHT(I,L,K,J); I index goes from 1 to KCG.

Repeat DG-37 through DG-39 for each movable gate (L = 1,NG(K,J)).

Skip DG-40 through DG-45 if internal boundary is not a lock and dam (KRCHT(K,J), DG-20, is not equal to 28).

40	PTAR(K,J)	Elevation (ft-msl) of water surface in headwater pool at upstream face of lock and dam; this elevation is considered the target pool elevation; the lock-master controls the flow through the dam via gates to maintain the pool elevation at this target elevation.
41	CHTW(K,J)	Elevation ft-msl) of water surface in tailwater pool at downstream face of lock and dam; this elevation is considered the elevation at which the lock-master can no longer control the flow through the dam and the flow becomes channel controlled; usually this elevation will be equal to or slightly less than the target pool elevation.

Skip DG-42 and DG-43 if running in NWSRFS (not in stand-alone mode).

Skip DG-42 and DG-43 if lock and dam defined with rating curve (ICHAN(K,J)=2) or lock and dam defined by target pool elevation (ICHAN(K,J)=3).

42	POLH(L,K,J)	Target pool elevation (same as PTAR(K,J)) for each time step; if POLH(L,K,J) = 0.0 is read-in, then PTAR(K,J) is used for POLH(L,K,J). L index goes from 1 to NU (DG-2). These elevations are associated with the inflow hydrograph time array.

Skip DG-43 if lock and dam will not be manually controlled (ICHAN(K,J) = 0, DG-28).

43	ITWT(L,K,J)	Parameter indicating if gates control the flow; if ITWT(L,K,J) = 0, flow is controlled by the gates; if ITWT(L,K,J) = 1, flow is not controlled by the gates, e.g., the entire dam is removed as in the case of the low lift dams on the lower Ohio River and the flow becomes channel controlled. L index goes from 1 to NU (DG-2). These gate control switches are associated with the

Data Group	Variable Name	Contents
		inflow hydrograph time array.

Skip DG-44 and DG-45 if no rating curve is generated for the lock and dam (ICHAN(K,J) is not equal to 2).

44	RHI(L,K,J)	Elevation (ft-msl) associated with flow, RQI(L,K,J), in rating curve describing the lock and dam. L index goes from 1 to 8; if less than 8 values are needed to describe the rating curve, set the remaining values to zero.
45	RQI(L,K,J)	Discharge (cfs) of rating curve corresponding to RHI(L,K,J). L index goes from 1 to 8; if less than 8 values are needed to describe the rating curve, set the remaining values to zero.

Skip DG-46 through DG-48 if internal boundary is not a bridge (KRCHT(K,J) is not equal to 35).

46	LAD(K,J)	Reach number corresponding to location of bridge K.
	EMBEL2(K,J)	Crest elevation (ft-msl) of uppermost portion of road embankment.
	EMBW2(K,J)	Crest length (ft) of uppermost portion of road embankment (including bridge opening) measured across valley and perpendicular to flow.
	EMBEL1(K,J)	Crest elevation (ft-msl) of lower portion (emergency overflow) of road embankment. If nonexistent, set EMBEL1(K,J) = 0.
	EMBW1(K,J)	Crest length (ft) of lower portion of road embankment measured across valley and perpendicular to flow. If nonexistent, set EMBW1(K,J) = 0.
	BRGW(K,J)	Width (ft) of top of road embankment as measured parallel to flow.
	CDBRG(K,J)	Coefficient of discharge of flow through bridge opening (see Chow, Open Channel Hydraulics, pages 476-490).
47	BRGHS(L,K,J)	Elevations (ft-msl) associated with widths of bridge opening; the brige opening should be closed by setting the last

Data Group	Variable Name	Contents
		BRGHS(L,K,J) slightly higher (say 0.1 ft.) than the previous value; start at invert and proceed upwards. L index goes from 1 to 8; if less than 8 values are needed to describe the bridge opening, set the remaining values to zero.
48	BRGBS(L,K,J)	Width (ft) associated with BRGHS(L,K,J) elevation of bridge opening; the bridge opening should be closed by setting the last BRGBS(L,K,J) = 0; start at invert and proceed upwards. L index goes from 1 to 8; if less than 8 values are needed to describe the bridge opening, set the remaining values to zero.

Skip DG-49 if internal boundary is not a dam or a bridge.

49**	TFH(K,J)	Time (hr) from beginning of breach formation until it reaches its maximum size in dam/bridge K.
	DTHDB(K,J)	Computational time step (hr) to be used after failure of dam/bridge K. If DTHDB(K,J) = 0, the time step size will be computed as TFH(K,J)/MDT; if multiple dams/bridges have failed, the smallest time step will be used during computations.
	HFDD(K,J)	Elevation (ft) of water when failure of dam/embankment K commences. If HFDD(K,J) < 0, failure commences at time equal to the absolute value of HFDD(K,J) (hr).
	BBD(K,J)	Final (maximum) width (ft) of bottom of breach.
	ZBCH(K,J)	Side slope (1 vertical : ZBCH(K,J) horizontal) of breach.
	YBMIN(K,J)	Lowest elevation (ft-msl) that bottom of breach reaches.
	BREXP(K,J)	Exponent used in development of breach. Varies from 1 to 4; a typical value is 1.
	CPIP(K,J)	Centerline elevation (ft-msl) of piping breach. If breach is overtopping, set CPIP(K,J) = 0.

Repeat DG-26 through DG-49 for each dam/bridge on river J, K = 1,NDB where NDB is the number of dams/bridges; then repeat again for each river (J = 1,JN).

Skip DG-50 and DG-51 if NQL(J) is less than or equal to 0.

50	LQ1(K,J)	Sequence number of upstream cross section with lateral inflow.

Data Group	Variable Name	Contents
		LQ1(K,J) must be placed in columns 1-10.
	STNAME(K,J)	Time series identifier for cross section with lateral flow. STNAME(K,J) may be up to 8 characters long and it must begin in column 13. Omit this field if running in stand-alone mode.
	DTYPE(K,J)	Time series data type for cross section with lateral flow. DTYPE(K,J) may be up to 4 characters long and it must begin in column 22. Omit this field if running in stand-alone mode.

Skip DG-50 if running in NWSRFS (not stand-alone mode).

51	QL(L,K,J)	Lateral inflow at cross section LQ1(K,J). L index goes from 1 to NU. This hydrograph is associated with the inflow hydrograph time array.

Repeat DG-50 and DG-51 for each lateral flow (K = 1,NQL(J), DG-13); then repeat again for each river (J = 1,JN).

Skip DG-52 through DG-55 if NGAGE(J) = 0 (DG-13).

52	NGS(K,J)	Sequence number of cross section that is an observed/plotting station. NGS(K,J) must be placed in columns 1-10.
	GZ(K,J)	Gage correction to convert observed stages to mean sea level datum. GZ(K,J) must be placed in columns 11-20. Omit this field if KPL = 2 (DG-4) or IOBS is less than or equal to 0 (DG-5).
	STNAME(K,J)	Time series identifier for cross section where observed data will be available or where plotting will be done. STNAME(K,J) may be up to 8 characters long and it must begin in column 23 (it must begin in column 13 if GZ(K,J) is omitted). If running in stand-alone mode, STNAME(K,J) may be up to 20 characters long.
	DTYPE(K,J)	Time series data type for cross section where observed data will be available or where plotting will be done. DTYPE(K,J) may be up to 4 characters long and it must begin in column 32 (it must begin in column 22 if GZ(K,J) is omitted). Omit this field if running in stand-alone mode.

Skip DG-53 if running in NWSRFS (not stand-alone mode) or IOBS (DG-5) is less than

Data Group	Variable Name	Contents

or equal to 0.

53	STT(L,K,J)	Observed stage or discharge time series at cross section NGS(K,J). L index goes from 1 to NU. The time array associated with this hydrograph is the same as for the inflow hydrograph.

Skip DG-54 & DG-55 if KPL (DG-4) is not equal to 3 or IOBS (DG-5) is less than or equal to 0.

Skip DG-54 if running in stand-alone mode (not a part of NWSRFS).

54	STNAME(K,J)	Time series identifier for cross section where observed discharges will be available or where discharges will be plotted. STNAME(K,J) may be up to 8 characters long and it must begin in column 3.
	DTYPE(K,J)	Time series data type for cross section where observed discharges will be available or where discharges will be plotted. DTYPE(K,J) may be up to 4 characters long and it must begin in column 12. Omit this field if running in stand-alone mode.

Skip DG-55 if running in NWSRFS (not stand-alone mode).

55	STQ(L,K,J)	Observed discharge time series at cross section NGS(K,J), DG-50. L index goes from 1 to NU (DG-2). The time array associated with this hydrograph is the same as for the inflow hydrograph.

Repeat DG-52 through DG-55 for each gaging station (K = 1,NGAGE(J), DG-13); then repeat the group for each river (J = 1,JN).

Skip DG-56 if NSTR(J) = 0 (DG-13) or if running in stand-alone mode (not a part of NWSRFS).

56	NST(K,J)	Sequence number of upstream cross section with an output time series. NST(K,J) must be placed in columns 1-10.
	STNAME(K,J)	Time series identifier for cross section with output time series. STNAME(K,J) may be up to 8 characters long and it must begin in column 13.
	DTYPE(K,J)	Time series data type for cross section with output time series.

Data Group	Variable Name	Contents
		DTYPE(K,J) may be up to 4 characters long and it must begin in column 22.
	GZO(K,J)	Gage correction to convert output water surface elevations to stages. GZO(K,J) must be placed in columns 26-36. If the output time series is not stage, set GZO(K,J) = 0.

Repeat DG-56 for each output time series (K = 1,NSTR(J), DG-13); then repeat the group for each river (J = 1,JN).

Skip DG-57 if IOBS is greater than or equal to 0.

57	TPG(J)	Time (hr) from initial steady flow to peak of specified upstream boundary hydrograph (used in mathematical function describing the hydrograph).
	RHO(J)	Ratio of peak value of specified hydrograph to initial value of the hydrograph.
	GAMA(J)	Ratio of time TG to TPG(J), where TG is time from initial steady flow to center of gravity of the specified hydrograph. GAMA(J) must be > 1.
	YQI(J)	Initial steady discharge (cfs) or water surface elevation (ft-msl) at the upstream boundary.

Repeat DG-57 for each river (J = 1,JN).

Skip DG-58 through DG-60 if KU(J) > 2 (DG-13).

Skip DG-58 and DG-59 if running in NWSRFS (not stand-alone mode).

58	ST1(L,J)	Stages (ft) or discharges (cfs) at upstream boundary of river J. L index goes from 1 to NU (DG-2).

Skip DG-59 if DTHYD>0 (DG-1).

59*	T1(L,J)	Time array associated with upstream hydrograph ST1(L,J). L index goes from 1 to NU (DG-2).

Skip DG-60 if running in stand-alone mode (not a part of NWSRFS) and KU(J)=2 (DG-13).

Data Group	Variable Name	Contents
60*	STM(J)	Minimum stage (ft) or discharge (cfs) allowed at the upstream boundary. STM(J) must be placed in columns 1-10. Omit this parameter if running in stand-alone mode (not a part of NWSRFS).
	GZ1(J)	Gage correction to convert upstream stages to mean sea level datum. GZ1(J) must be placed in columns 11-20. Omit this parameter if KU(J) = 2 (DG-13).
	STNAME(J)	Time series identifier for stages (ft) or discharges (cfs) at the upstream boundary. STNAME(J) may be up to 8 characters long and it must begin in column 23 (it must begin in column 13 if GZ1(J) is omitted). Omit this parameter if running in stand-alone mode (not a part of NWSRFS).
	DTYPE(J)	Time series data type for observed stages (Ft) or discharges (cfs) at the upstream boundary. DTYPE(J) may be up to 4 characters long and it must begin in column 32 (it must begin in column 22 if GZ1(J) is omitted). Omit this parameter if running in stand-alone mode (not a part of NWSRFS).

Repeat DG-58 through DG-60 for each river (J = 1,JN).

Skip DG-61 through DG-67 if KD(J) = 0 (DG-13).

Skip DG-61 through DG-65 if KD(1) > 2 (DG-13).

Skip DG-61 if running in NWSRFS (not stand-alone mode).

61	STN(K,1)	Observed stages (KD(1) = 1) or discharges (KD(1) = 2) at downstream boundary of main river. K index goes from 1 to NU (DG-2).

Skip DG-62 if running in stand-alone mode (not a part of NWSRFS) and KD(1) is not equal to 1 or 3 (DG-13).

62	GZN	Gage correction (ft-msl) to convert downstream stages to mean sea level datum. GZN must be placed in columns 1-10. Omit this field if KD(1) is not equal to 1 or 3(DG-13).
	STNAME	Time series identifier for stages (KD(1) = 1, DG-13) or discharges (KD(1) = 2, DG-13) at downstream boundary of main river. STNAME may be up to 8 characters long and it

Data Group	Variable Name	Contents
		must begin in column 13 (it must begin in column 1 if GZN is omitted). Omit this parameter if running in stand-alone mode (not a part of NWSRFS).
	DTYPE	Time series data type for stages (ft) or discharges (cfs) at the downstream boundary. DTYPE may be up to 4 characters long and it must begin in column 22 (it must begin in column 12 if GZN is omitted). Omit this parameter if running in stand-alone mode (not a part of NWSRFS).

Skip DG-63 through DG-65 if running in stand-alone mode (not a part of NWSRFS).

Skip DG-63 and DG-64 if the NOS tide is not used for the downstream boundary (KD(1), DG-13, is not equal to 0).

Data Group	Variable Name	Contents
63	STNAME	Time series identifier for NOS tide at the downstream boundary. STNAME may be up to 8 characters long and it must begin in column 3.
	DTYPE	Time series data type for NOS at the downstream boundary. DTYPE may be up to 4 characters long and it must begin in column 13.
64	STNAME	Time series identifier for the adjusted tide at the downstream boundary. STNAME may be up to 8 characters long and it must begin in column 3.
	DTYPE	Time series data type for the adjusted tide at the downstream boundary. DTYPE may be up to 4 characters long and it must begin in column 13.

Skip DG-65 if computed hydrographs are not adjusted (IOBS, DG-5, is less than 2).

Data Group	Variable Name	Contents
65	STNAME(K,J)	Time series identifier for cross section location where the computed stage or discharge hydrograph will be adjusted based on observed data. STNAME may be up to 8 characters long and it must begin in column 3.
	DTYPE(K,J)	Time series data type for cross section location where the computed stage or discharge hydrograph will be adjusted based on observed data. DTYPE may be up to 4 characters long and it must begin in column 13.

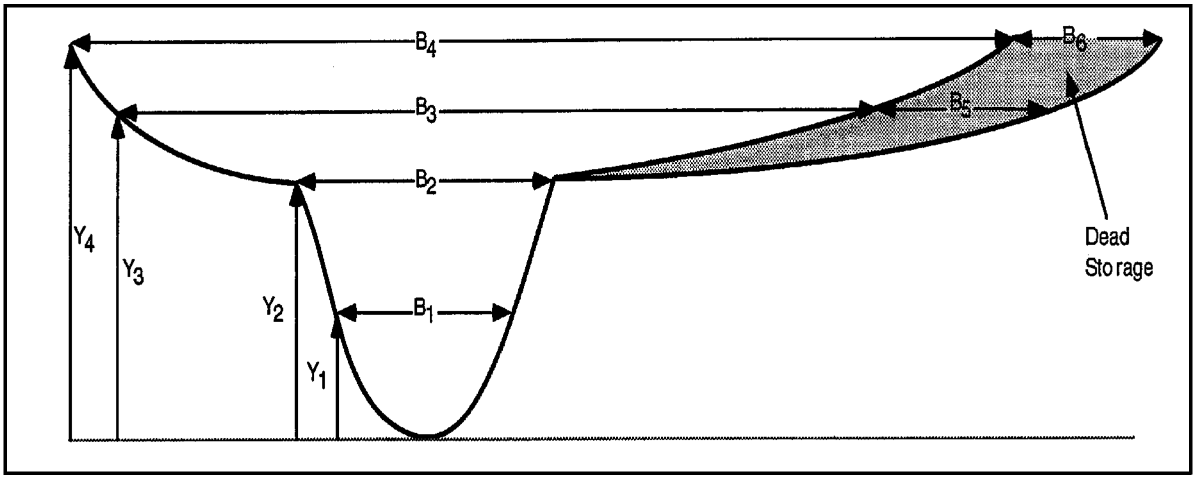

Figure 20.1 Cross Section Description for Calibration Option

Repeat DG-65 for each gaging station (K = 1,NGAGE(J), DG-13); then repeat the group for each river (J = 1,JN).

Skip DG-66 if KD(1), DG-13, is not equal to 0, or if running in stand-alone mode (not a part of NWSRFS).

Skip DG-66 through DG-68 if NYQD = 0 (DG-3) OR KD(1) is not equal to 3 (DG-13).

Skip DG-66 if running in stand-alone mode (not a part of NWSRFS).

66	STNAME	Rating curve identifier for cross section at downstream boundary on main river. STNAME may be up to 8 characters long and it must begin in column 1.

Skip DG-67 and DG-68 if running in NWSRFS (not stand-alone mode).

67	YQD(K)	Stages (ft) used to define the empirical rating curve at the downstream boundary on the main river. K goes from 1 to NYQD.
68	QYQD(K)	Discharge (cfs) used to define the empirical rating curve at the downstream boundary on the main river. K goes from 1 to NYQD.

Skip DG-69 if KD(1) is not equal to 5.

69	SLFI(1)	Bed/initial water surface slope (ft/ft) of the main river. This slope is used to generate the single-valued rating curve at the downstream boundary.

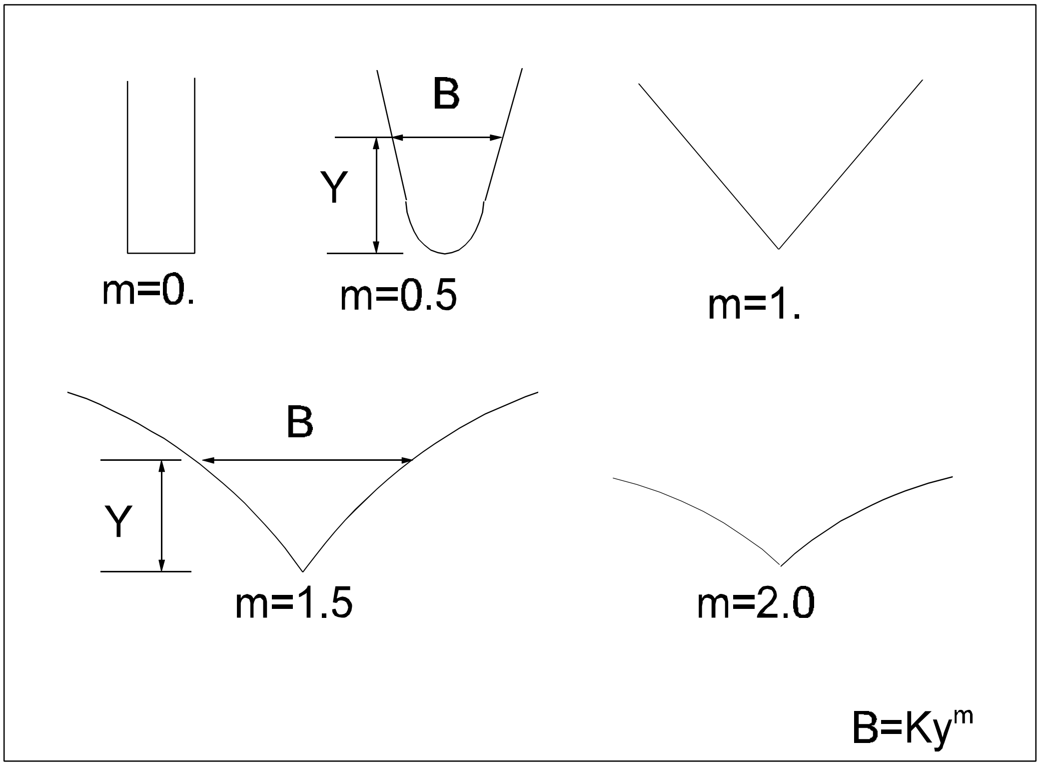

Figure 20.2 Cross Section Shapes for Power Function $B=kY^m$

Data Group	Variable Name	Contents

Skip DG-70 and DG-71 if internal boundary is not a lock and dam (KRCHT(K,J) is not equal to 28, DG-20) or if running in stand-alone mode (not a part of NWSRFS).

70	STNAME(K,J)	Time series identifier for cross section with target pool elevations. STNAME(K,J) may be up to 8 characters long and it must begin in column 3.
	DTYPE(K,J)	Time series data type for cross section with target pool elevations. DTYPE(K,J) may be up to 4 characters long and it must begin in column 12.

Skip DG-71 if lock and dam will never switch to channel control (ICHAN(K,J) = 0, DG-28)

71	STNAME(K,J)	Time series identifier for cross section with gate control switches. STNAME(K,J) may be up to 8 characters long and it must begin in column 3.
	DTYPE(K,J)	Time series data type for cross section with gate control

Data Group	Variable Name	Contents
		switches. DTYPE(K,J) may be up to 4 characters long and it must begin in column 12.

Repeat DG-70and DG-71 for each lock and dam (KRCHT(K,J) = 28, DG-20); then repeat the group for each river (J = 1,JN).

Skip DG-72 through DG-77 if NP is not equal to -4.

72	IFXC(I,J)	Parameter indicating if cross section has special properties when CALXS option is used. If no special properties, IFXC(I,J) = 0; if actual section is to be read in, IFXC(I,J) = 1; I index goes from 1 to NBT(J), DG-12.
73	HSC(J)	Invert elevation (ft) at the most upstream cross section on river J.
74	KAM	Parameter indicating the method for reading in cross sections in the calibration reach. If KAM = 0, cross sections are described as top width versus depth (B versus Y) at key points in the cross section (see Figure 20.1); if KAM = 1, cross sections are described as the power function $B = kY^m$ where m is a shape factor and k is a scaling factor (see Figure 20.2).
	CHNMN(I,J)	The minimum acceptable Manning n value computed during automatic calibration for calibration reach I. The default value is 0.013.
	CHNMX(I,J)	The maximum acceptable value of Manning n value computed during automatic calibration for calibration reach I. The default value is 0.25.
	SXS	Average channel bottom slope (ft/mi) along calibration reach I.

Skip DG-75 if KAM= 0.

75	FKC(I,J)	Scaling parameter of the channel in-bank portion of cross section in calibration reach I described in power function.
	FMC(I,J)	Shape factor for the channel in-bank portion of cross section in calibration reach I described in power function.
	FKF(I,J)	Scaling parameter of floodplain portion of cross section in calibration reach I described in power function.

Data Group	Variable Name	Contents
	FMF(I,J)	Shape factor for floodplain portion of cross section in calibration reach I described in power function.
	FKO(I,J)	Scaling parameter of dead storage (inactive) portion of cross section in calibration reach I described in power function.
	FMO(I,J)	Shape factor for dead storage (inactive) portion of cross section in calibration reach I described in power function.
	HB	Depth (ft) of cross section at top of bank.
	HF	Depth (ft) of cross section at top of floodplain.

Skip DG-76 and DG-77 if KAM = 1.

76	B1	Active top width (ft) of typical cross section in calibration reach I at depth Y1 (half of channel depth).
	B2	Active top width (ft) of typical cross section in calibration reach I at depth Y2 (top of bank).
	B3	Active top width (ft) of typical cross section in calibration reach I at depth Y3 (midpoint of floodplain). Enter zero if no floodplain.
	B4	Active top width (ft) of typical cross section in calibration reach I at depth Y4 (maximum flood depth). Enter zero if no floodplain.
	B5	Dead storage (inactive) top width (ft) of typical cross section in calibration reach I at depth Y3. Enter zero if no inactive storage.
	B6	Dead storage (inactive) top width (ft) of typical cross section in calibration reach I at depth Y4. Enter zero if no inactive storage.
77	Y1	Depth (ft) of typical cross section in calibration reach I at mid-point between the invert and top of bank.
	Y2	Depth (ft) of typical cross section in calibration reach I at top of bank.
	Y3	Depth (ft) measured from invert of typical cross section in

Data Group	Variable Name	Contents
		calibration reach I to midpoint between the top of bank and estimated maximum flood elevation.
	Y4	Depth (ft) of typical cross section in calibration reach I at an estimated maximum flood elevation.

Repeat DG-74 through DG-77 for each calibration reach (I = 1,NGAGE(J)-1).

78*	FLST(I,J)	Elevation (ft-msl) at which flooding commences. If no flood stage, enter zero.
	YDI(I,J)	Initial water surface elevation (ft-msl) at cross section I. If steady state conditions exist, the YDI value at the downstream location of the main river and pool levels behind dams must be read in (all other values are entered as zero) and the model will do backwater computations; otherwise, all values are read in. Omit this parameter if running in NWSRFS (not stand-alone mode).
	QDI(I,J)	Initial discharge (cfs) at cross section I. If steady state conditions exist, all QDI values are read in as zero and the QDI values are generated by summation of flows from upstream to downstream. If KU(J) is not equal to 2, the upstream discharge (QDI(I,J)) must be read in. If unsteady-state condition exists, all QDI values are read in. Omit this parameter if running in NWSRFS (not stand-alone mode).
	AS(1,I,J)	Active channel cross-sectional area (sq ft) below the lowest HS elevation in cross section I.

Skip DG-79 through DG-85 if NP = -4 and IFXC(I,J) = 0.

79*	HS(L,I,J)	Elevation (ft-msl) corresponding to each top width BS(L,I,J). Elevations are entered from the bottom of the cross section upward; L index goes from 1 to NCS.
80*	BS(L,I,J)	Top width (ft) of active flow portion of channel/valley cross section corresponding to each elevation HS(L,I,J). L index goes from 1 to NCS.

Skip DG-81 and DG-82 if KFLP=0.

81	BSL(L,I,J)	Top width (ft) of active flow portion of left floodplain corresponding to each elevation HS(L,I,J). L index goes from 1

Data Group	Variable Name	Contents
		to NCS.
82	BSR(L,I,J)	Top width (ft) of active flow portion of right floodplain corresponding to each elevation HS(L,I,J). L index goes from 1 to NCS.

Skip DG-83 and DG-84 if KFLP is less than or equal to 1 .

83	HKC(L,I,J)	Elevation (ft-msl) corresponding to the conveyance QKC(L,I,J). L index goes from 1 to KFLP.
84	QKC(L,I,J)	Conveyance corresponding to elevation HKC(L,I,J). I index goes from 1 to KFLP.
85*	BSS(L,I,J)	Top width (ft) of dead storage (inactive) portion of channel/valley cross section corresponding to each elevation HS(L,I,J). K index goes from 1 to NCS; if no inactive storage exists, enter zero.

Repeat DG-78 through DG-85 for each cross section (I = 1,NBT(J)).

Repeat DG-72 through DG-85 for each river (J = 1,JN).

Skip DG-86 if KFLP is not equal to 1.

86	SNM(L,I,J)	Sinuosity coefficient (channel flow-path length/floodplain flow-path length corresponding to each elevation HS(L,I,J). L index goes from 1 to NCS.

Repeat DG-86 for all reaches (I = 1,NBT(J)-1).

87*	FKEC(I,J)	Expansion or contraction coefficients. Expansion coefficients vary from -.05 to -.75 and contraction coefficients vary from +.10 to +.40, the larger values are associated with very abrupt changes in cross section along the river; if expansion/contraction is negligible, set FKEC(I,J) = 0. I index goes from 1 to NBT(J) - 1.
88*	NCM(I,J)	Station number of upstream-most station in subreach that has the same Manning n. I index goes from 1 to NRCM1(J).
89*	CM(L,I,J)	Manning n corresponding to each YQCM(L,I,J) value. L index goes from 1 to NQCM(J); if NQCM(J) = 0, Manning n values are treated as in the DAMBRK program where Manning n is a function of the average elevation between two cross sections and L index goes from 1 to NCS.

Data Group	Variable Name	Contents

Skip DG-90 and DG-91 if KFLP = 0.

90	CML(L,I,J)	Manning n corresponding to each YQCM(L,I,J) value for left floodplain. L index goes from 1 to NQCM(J); the same rules apply for NQCM(J) as were previously stated in DG-86.
91	CMR(L,I,J)	Manning n corresponding to each YQCM(L,I,J) value for right floodplain. L index goes from 1 to NQCM(J); the same rules apply for NQCM(J) as were previously stated in DG-86.

Skip DG-92 if NQCM(J) = 0.

92	YQCM(L,I,J)	Water surface elevation (ft-msl) or discharges (cfs) associated with Manning n. L index goes from 1 to NQCM(J).

Repeat DG-89 through DG-92 for each Manning reach (I = 1, NRCM1(J)).

Repeat DG-86 through DG-92 for each river (J = 1,JN).

Skip DG-93 through DG-99 if DG-68 if running in stand-alone mode (not a part of NWSRFS).

Skip DG-93-95 if IOBS (DG-5) is not equal to 3

93	NSLC(J)	Total number of slices used to adjust the computed time series. J index goes from 1 to JN.
94	NQSL(J)	Parameter indicating adjustment statistics are a function of water surface elevation (NQSL (J) = 0), or discharge (NQSL (J) = 1). J index goes from 1 to JN.
95	SLICE(L,K,J)	Stage (ft) or discharge (cfs) range into which the statistics lie. A hydrograph will be divided into NSLC(J) elevation or discharge ranges (slices) and adjusted based on the root mean square error and bias. L index goes from 1 to NSLC(J).

Skip DG-96 through DG-99 if IOBS, DG-5, is less than 2.

96	FRMSO(L,K,J)	Root mean square error (rms) on the falling limb of the hydrograph within each slice. This value is used when no observed data exists in the slice for the current runtime. If FRMSO (L,K,J) = 0, no adjustment is made to the computed stage. L index goes from 1 to NSLC(J).
97	FBIASO(L,K,J)	Bias associated with FRMSO (L,K,J). L index goes from 1 to NSLC(J).
98	RRMSO(L,K,J)	Root mean square error (rms) on the rising limb of hte

Data Group	Variable Name	Contents
		hydrograph within each slice. This value is used when no observed data exists in the slice for the current runtime. If RRMSO (L,K,J) = 0, no adjustment is made to the computed stage. L index goes from 1 to NSLC(J).
99	RBIASO(L,K,J)	Bias associated with RRMSO (L,K,J). L index goes from 1 to NSLC(J).

Repeat DG-95 through DG-99 for each adjusted time series (K = 1, NGAG(J), DG-13); then repeat the group for each river (J = 1, JN).

Skip DG-100 through DG-101 if ICOND=1 (DG-2).

100	YDI(I,J)	Initial water surface elevation referenced to msl (ft) at each cross section. Each field represents a cross section. I=1,NBT(J) (DG-12). If all fields are left blank, the program will generate the YDI's via linear interpolation between gaging stations (this is allowed when gaging stations exist at the upstream extremities of all rivers and the downstream extremity of the main stem). If the upstream extremity of each river does not have an observed hydrograph, this YDI value must be supplied along with all the blanks for the other YDI's. If all fields are left blank except at the downstream extremity of the main stem river where the actual YDI is read in, the program will generate the YDI's via a solution of the steady flow backwater equation.

Repeat DG-100 for each river (J=1,JN).

101	QDI(I,J)	Initial discharges (cfs) at each cross section Each field represents a cross section I=1,NB(J) (DG-12). If all fields are left blank except at the upstream extremity of each river, the program will generate the QDI's by summation of the flows from the upstream to downstream boundaries, including tributary inflow to the main stem and lateral inflow occurring along either the main stem or tributaries.

Repeat DG-101 for each river (J=1,JN).

Skip DG-102 if no lateral flow in the system (NQL(J)=0, DG-13, for all rivers J=1,JN)

102	QLI(K,J)	Initial lateral flow (cfs) for each reach with lateral flow. Each field represents a lateral flow reach. K=1,NQL(J) (DG-13).

Repeat DG-102 for each river with lateral flow (NQL(J) not equal to 0, J=1,JN)

Skip DG-103 and DG-104 if no lock and dams in the system (all KRCHT values equal zero, DG-20).

103	PLTI(K,J)	Initial target pool elevation for each lock and dam. Each field represents a lock and dam, K=1,NUMLAD(J) where NUMLAD(J) is the sum of KRCHT=28, DG-20).

Repeat DG-103 for each river with locks and dams.

104	IWTI(K,J)	Initial gate control switch for each lock and dam. Each field represents a lock and dam, K=1,NUMLAD(J) where NUMLAD(J) is the sum of KRCHT=28, DG-20). K=1,NUMLAD(J).

Repeat DG-104 for each river with locks and dams.

Skip DG-105 and DG-106 if NFGRF = 1 (DG-4).

105*	MESAGE	40-character message describing the data set for use in FLDGRF.
106*	RIVER(J)	16-character name associated with river J. There is no comment line prior to this data group.20.2 Alphabetical Listing of Data Variables for FLDWAV

VARIABLE	DATA GROUP	DEFINITION OF THE VARIABLE
AS(1,I,J)	78	Active channel area below the lowest HS elevation
ALOS(J)	17	Loss distribution coefficient
ATF(J)	12	Acute angle tributary makes with main river at its confluence
B1	76	Active top width at depth Y1 (calibration)
B2	76	Active top width at depth Y2 (calibration)
B3	76	Active top width at depth Y3 (calibration)
B4	76	Active top width at depth Y4 (calibration)
B5	76	Inactive top width at depth Y3 (calibration)
B6	76	Inactive top width at depth Y4 (calibration)
BBD(K,J)	49	Final width of bottom of breach
BLVMX(L)	21	Final width of levee crevasse
BREXP(K,J)	49	Exponent used in development of breach
BRGBS(L,K,J)	48	Width associated with bridge opening
BRGHS(L,K,J)	47	Elevations associated with widths of bridge opening
BRGW(K,J)	46	Width of top of road embankment
BS(L,I,J)	80	Top width of active flow portion of cross section
BSL(L,I,J)	81	Top width of active flow portion of left floodplain
BSR(L,I,J)	82	Top width of active flow portion of right floodplain
BSS(L,I,J)	85	Top width of inactive portion of cross section
CDBRG(K,J)	46	Discharge coefficient of flow through bridge opening
CDOD(K,J)	28	Discharge coefficient for uncontrolled weir flow over the top of the

DATA VARIABLE	GROUP	DEFINITION OF THE VARIABLE
		dam
CGD(K,J)	29	Discharge coefficient for gate flow
CHNMN(I,J)	74	Minimum acceptable calibrated Manning n value
CHNMX(I,J)	74	Maximum acceptable calibrated Manning n value
CHTW(K,J)	41	Elevation of tailwater pool at downstream face of lock and dam
CLL(K,J)	28	Dam crest length less the length of spillway and gates
CM(L,I,J)	89	Manning n for channel
CML(L,I,J)	90	Manning n for left floodplain
CMR(L,I,J)	91	Manning n for right floodplain
COFW(J)	12	Coefficient of wind stress
CPIP(K,J)	49	Centerline elevation of piping breach
CRESL(L,K,J)	31	Variable length of dam crest for a given elevation
CSD(K,J)	29	Discharge coefficient of uncontrolled spillway
DESC	0-2	Type of output display
DHLV	10	Difference between max and min levee crest elevations
DPLV(L)	22	Diameter of flood drainage pipe
DTEXP	7	Computational time step for explicit routing
DTHDB(K,J)	49	Computational time step after dam/bridge failure
DTHII	7	Initial computational time step
DTHIN(K)	8	Variable computational time step
DTHLV	10	Computational time step during levee overtopping/failure
DTHPLT	7	Plotting/printing time interval
DTHYD	1	Time interval of all input hydrographs
DTOUT	1	Time interval of all output hydrographs
DTYPE(K,J)	50,52,54	Time series data type at a cross-section
DXM(I,J)	19	Minimum computational distance interval between sections
EMBEL1(K,J)	46	Crest elevation of lower portion (emergency overflow) of road embankment
EMBEL2(K,J)	46	Crest elevation of uppermost portion of road embankment
EMBW1(K,J)	46	Crest length of lower portion of road embankment
EMBW2(K,J)	46	Crest length of uppermost portion of road embankment
EPQJ(J)	12	Discharge tolerance in tributary iteration scheme
EPSY	1	Depth tolerance in Newton-Raphson iteration scheme
F1	1	θ weighting factor in finite difference technique
FBIASO(L,K,J)	97	Bias associated with FRMS
FKC(I,J)	75	Scaling parameter of channel portion of synthetic section
FKEC(I,J)	87	Expansion or contraction coefficient
FKF(I,J)	75	Scaling parameter of floodplain portion of synthetic section
FKO(I,J)	75	Scaling parameter of inactive portion of synthetic section
FLST(I,J)	78	Elevation at which flooding commences
FMC(I,J)	75	Shape factor for channel portion of synthetic section
FMF(I,J)	75	Shape factor for floodplain portion of synthetic section
FMO(I,J)	75	Shape factor for inactive portion of synthetic section
FRDFR	7	Window for critical Froude number (mixed flow)
FRMSO(L,K,J)	96	Root mean square error (rms) on falling limb of the hydrograph
GAMA(J)	57	Ratio of time from initial steady flow to center of gravity of the specified hydrograph
GHT(I,L,K,J)	39	Distance from bottom of gate to sill
GSIL(L,K,J)	37	Elevation of the bottom of gate

DATA VARIABLE	GROUP	DEFINITION OF THE VARIABLE
GWID(L,K,J)	37	Width of gate opening
GZ(K,J)	52	Gage correction to convert observed stages to mean sea level datum (msl)
GZ1(J)	60	Gage correction to convert observed stages at upstream boundary to msl
GZN	62	Gage correction to convert observed stages at downstream boundary to msl
GZO(K,J)	56	Gage correction to convert WSEL to stages
HB	75	Elevation of section at top of bank (calibration)
HCRESL(L,K,J)	30	Elevation associated with variable length of dam crest
HDD(K,J)	28	Elevation of top of dam
HF	75	Elevation of section at top of floodplain (calibration)
HFDD(K,J)	49	Elevation of water when dam failure commences
HFLV(L)	21	Elevation of water surface when levee starts to fail
HGTD(K,J)	29	Elevation of center of gate openings; also elevation of bottom of sill of time-dependent gate
HKC(L,I,J)	83	Elevation corresponding to conveyance
HLVMN(L)	21	Final elevation of bottom of levee crevasse
HPLV(L)	22	Centerline elevation of flood drainage pipe (levee)
HPOND(L)	23	Initial WSEL of storage pond (levee)
HS(L,I,J)	79	Elevation corresponding to each top width
HSAP(K,L)	25	Elevation corresponding to SAPOND (levee)
HSAR(L,K,J)	27	Elevation at which reservoir surface area is defined
HSC(J)	73	Invert elevation at the most upstream section
HSPD(K,J)	29	Elevation of uncontrolled spillway crest
HWLV(L)	21	Elevation of top of levee, ridge line, etc.
ICG(K,J)	29	Parameter for type of gate structure
IFXC(I,J)	72	Parameter indicating if section has special properties
ICHAN(K,J)	28	Dam control parameter
ICOND	2	Parameter indicating type of initial condition
IFUT(3 or 6)	2,13,14	Place holder for future enhancements
IOBS	5	Parameter indicating if observed data are available
ITMAX	2	Maximum number of iterations allowed in the Newton-Raphson iteration scheme
ITWT(L,K,J)	43	Parameter indicating whether or not the gates control the flow
IWF1(J)	16	Parameter indicating dry bed routing
IWTI(K,J)	104	Initial gage control switch for each lock and dam
JDBG1	6	First river with additional debug information
JDBG2	6	Last river with additional debug information
JN	2	Total number of rivers
JNK	4	Output print parameter
JNKDBG	6	Debug switch for additional information
KAM	74	Parameter indicating the method of reading in cross sections for calibration
KCG	3	Number of points in time-dependent spillway gate control curve
KD(J)	13	Parameter for the type of downstream boundary condition
KFLP	2	Floodplain (conveyance) parameter
KFTR(J)	14	Parameter for use of Kalman Filter option
KLOS(J)	14	Parameter indicating how volume losses are computed

DATA VARIABLE	GROUP	DEFINITION OF THE VARIABLE
KLPI(K)	15	Power (k) used in the LPI technique
KPL	4	Parameter for type of hydrograph to be plotted
KPRES	3	Parameter for method of computing hydraulic radius
KRCHT(I,J)	20	Parameter for routing method or internal boundary
KREVRS	4	Parameter for use of the low flow filter
KTERM	5	Parameter to print terms in equation of motion
KU(J)	13	Type of upstream boundary condition parameter
KWARM	2	Number of time steps used for warm-up procedure
LAD(K,J)	28,46	Reach number corresponding to internal boundary
LDBG1	6	First reach with debug information (calibration)
LDBG2	6	Last reach with debug information (calibration)
LQ1(K,J)	50	Number of section immediately upstream of lateral flow
MCMDBG	6	First iteration with debug information (calibration)
MDT	7	Divisor for determining the time step
MESAGE	105	40-character message describing the data set
METRIC	1	Parameter for units of input/output (English or Metric)
MIXF(J)	14	Parameter for the flow regime
MRU(J)	12	Number of river from which river J flows
MRV(J)	12	Number of river into which river J flows
MSG	0-1	Description of data set
MUD(J)	14	Dummy parameter; set MUD(J) = 0
NBT(J)	12	Total number of cross sections
NCG	3	Dummy parameter; set NCG = 0
NCM(I,J)	88	Section number of upstream-most station of Manning n
NCS	4	Number of values in table of top width vs. elevation
NET	2	Parameter denoting Network option
NFGRF	4	Parameter for generating FLDGRF data
NG(K,J)	36	Dummy variable
NGAGE(J)	13	Total number of observed hydrographs on river
NGS(K,J)	52	Sequence number of each observed/plotting station
NIFM(K)	11	Number of reach along the river with levee passing flow
NITO(K)	11	Number of reach along the river receiving flow (levee)
NJFM(K)	11	Number of river passing levee overtopping/failure flow
NJTO(K)	11	Number of river receiving flow from levee overtopping/ failure
NJUM(J)	12	Number of section along the main river immediately upstream of tributary confluence of the feeding river
NJUN(J)	12	Number of section along the main river immediately upstream of tributary confluence
NLEV	10	Total number of section reaches in the system with levees
NP	5	Parameter for use of Automatic Calibration option
NPEND	5	Last value in the computed stage hydrograph used in the statistics (calibration)
NPST	5	First value in the computed stage hydrograph used in the statistics (calibration)
NPT(1,J)	12	Beginning cross-section number for which debug information will be printed
NPT(2,J)	12	Final cross-section number for which debug information will be printed
NQCM(J)	13	Total number of values in the Manning table. Also denotes whether

DATA VARIABLE	GROUP	DEFINITION OF THE VARIABLE
		Manning n is a function of WSEL or discharge
NQL(J)	13	Total number of lateral flows on river
NQSL(J)	94	Parameter indicating statistics are a function of elevation or flow
NRCM1(J)	13	Total number of Manning n reaches on river
NSLCE(J)	93	Total number of slices used to adjust time series
NST(K,J)	56	Sequence number of output time series
NSTR(J)	13	Total number of time series to be stored on each river
NU	2	Number of values associated with observed hydrographs
NYQD	3	Number of values in rating curve at downstream boundary
PLTI(K,J)	103	Initial target pool elevation for each lock and dam
POLH(L,K,J)	42	Pool elevation for each time step
POWR1(J)	16	Exponent in power function for mud/debris flow
PTAR(K,J)	40	Target pool elevation
QDI(I,J)	78	Initial discharges
QKC(L,I,J)	84	Conveyance corresponding to elevation
QL(L,K,J)	51	Lateral inflow at cross section
QLI(K,J)	102	Initial lateral flow (cfs) for each reach with lateral flow
QLOS(J)	17	Loss as percent of total active flow
QTD(K,J)	28	Constant discharge through turbines
QTT(L,K,J)	32	Variable discharge through turbines
QYQD(K)	68	Discharge defined in downstream empirical rating curve
RBIASO(L,K,J)	97	Bias associated with RRMS
RHI(L,K,J)	34	Head above spillway crest or gate center
RHO(J)	57	Ratio of peak flow to initial flow of inflow hydrograph
RIVER(J)	106	16-character name associated with each river
RQI(L,K,J)	35	Discharge of spillway or gate rating curve
RRMSO(L,K,J)	96	Root mean square error (rms) on rising limb of the hydrograph
SAPOND(K,L)	24	Surface area of storage pond corresponding to HSAP(K,L)
SAR(L,K,J)	26	Surface area of reservoir corresponding to HSA(L,K,J)
SHR1(J)	16	Yield stress of shear strength for mud/debris flows
SLFI(1)	69	Bed/initial water surface slope
SLICE(L,K,J)	95	Stage (ft) or discharge (cfs) range into which the statistics lie
SLV(L)	21	Slope of levee L
SNM(L,I,J)	86	Sinuosity coefficient
SPL(K,J)	29	Crest length of uncontrolled spillway
ST1(L,J)	58	Observed stages or discharges at upstream boundary
STM(J)	60	Minimum stage or discharge allowed at the upstream boundary
STN(1)	61	Observed hydrograph at downstream boundary
STNAME(K,J)	50,52,54	8- or 20-character name associated with each gaging station
STQ(L,K,J)	55	Observed discharge hydrograph at gaging station
STT(L,K,J)	53	Observed stage or discharge hydrograph at each gaging station
SXS	74	Average channel bottom slope (calibration)
T1(L,J)	59	Time array associated with upstream hydrograph
TDBG1	6	Time at which additional debug information begins
TDBG2	6	Time at which additional debug information ends
TDTIN(K)	9	Time at which DTIN(K) is no longer used
TEH	7	Time at which routing computations will terminate
TFH(K,J)	49	Time of failure of the structure
TFLV(L)	21	Time of levee failure (crevasse)

DATA VARIABLE	GROUP	DEFINITION OF THE VARIABLE
TGHT(I,L,K,J)	38	Time associated with gate opening
THETA	1	Acceleration factor to solve tributary junction problem
TPG(J)	57	Time from initial flow to peak flow of upstream boundary hydrograph
TQT(L,K,J)	33	Time associated with discharge through turbines
UW1(J)	16	Unit weight of mud/debris flow
VIS1(J)	16	Dynamic viscosity of mud/debris flow
VWIND(J)	12	Wind velocity
WCLV(L)	21	Weir-flow discharge coefficient (levee)
WINAGL(J)	12	Acute angle that wind makes with the channel axis
XLOS(1...2,J)	17	Location where flow loss starts and ends
XFACT	1	Units conversion factor for location of computation points
XT(I,J)	18	Location of section where computations are made
Y1	77	Depth of typical section at midpoint between the invert and top of bank (calibration)
Y2	77	Depth of typical section at top of bank (calibration)
Y3	77	Depth of typical cross section to midpoint between the top of bank and estimated maximum flood elevation
Y4	77	Depth of typical cross section at estimated maximum flood elevation (calibration)
YBMIN(K,J)	49	Lowest elevation that bottom of breach reaches
YDI(I,J)	78	Initial water surface elevations
YQCM(L,I,J)	92	WSEL or discharges associated with Manning n
YQD(K)	67	Stages corresponding to QYQD(K)
YQI(J)	57	Initial discharge or WSEL at upstream boundary
ZBCH(K,J)	49	Side slope of breach